**Template | Unit Enhancement**

***ENGINEERING DESIGN***

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Background Information**

**Instructional Materials Title:** *Sound*

**Publication Date:** 1997

**Work Group Participants:** Cathy Alward*,* Daniel Barkley, Anela Deisler, Martha May, Chris Paul

**Date Developed:** August 22, 2013

**High Leverage Lesson (Title and Page Number):** Lesson 6, “Vibrations We Can’t See”, *Teacher’s Guide* p. 49

**Rationale**

**- Why we identified this particular lesson** There is an opportunity to optimize the lesson by adding an engineering concept; There is an opportunity to create a system with moving parts to solve a problem.

**- Connections to NGSS and WA Science Standards [4-5PS3A, 4-5PS3D, 2-3SYSA, 2-3SYSB, 2-3INQB] ADD [3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3]**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Engineering* Lesson Enhancement**

**Overview**

· **Identification of where within the High Leverage Lesson to insert enhancement:** Change the order of the lesson and insert the enhancement at the beginning of the lesson.

· **Key instructional strategies and tools needed:** Add engineering design framework, focusing on understanding the framework and designing a solution to the problem; SPS *Sound* kit, no additional materials needed.

**Part 1: Lesson Modifications to Lead Up to *Engineering Task***

On *Teacher’s Guide* p. 51, no longer preassemble demonstration slide whistle and don’t show instructions for the slide whistle.

Present the available parts without comment.

The problem is to create an instrument.

Constraints:

Use only one of each part;

Cannot use any additional materials;

Cannot keep it secret;

Must use all parts;

Ten minutes

**Don’t put your mouth on anything or anything in your mouth!**

Criteria:

Must make at least three pitches.

**Part 2: *Engineering* Learning Sequence**

Introduce the engineering design framework: define the problem, develop solutions, optimize solution. Discuss the engineering process. Then explain that the problem is defined and today we will be developing solutions to the problem. We will address the idea of optimization in a later lesson.

Students will use the engineering design process to create an instrument that will demonstrate three different pitches.

**Part 3-A: Engineering Task**

Present the available parts without comment.

The problem is to create an instrument.

Constraints:

Use only one of each part;

Cannot use any additional materials;

Cannot keep it secret;

Must use all parts;

Ten minutes

**Don’t put your mouth on anything or anything in your mouth!**

Criteria:

Must make at least three pitches.

Step 1 Present the engineering design framework. Introduce the problem, constraints and criteria.

Step 2 Display the materials available. Leave them on the overhead.

Step 3 Individually, make two drawings of instruments you could build using all of the materials. Write a description of how each solves the problem while meeting the criteria/constraints.

Step 4 When students have finished their individual work, transition to partner work. Give student partners their materials. They will discuss their designs and choose one that they think might work well to meet the criteria then, build the instrument.

Step 5 Circulate through the classroom (if students finish at different rates) or as a whole group (if students finish at the same time. Have students demonstrate the instruments they made and the pitches that they can make.

Step 6 Refine the instruments to make sure that all students were able to demonstrate the three pitches.

Step 7 Students will complete design sheet questions three and four in their notebooks.

Step 8 Teacher evaluates the engineering concepts based on the drawings and descriptions of the solutions in the student notebooks: Do they show workable designs? Does the design show development?

Step 9 Present the remainder of lesson 6 (p. 51-start at step 5).

**Part 3-B: Assessment Rubric**

|  |  |  |
| --- | --- | --- |
| **Criteria of Engineering Understanding** | | |
|  | Shows Understanding | Needs support |
| Brainstorm/explore multiple solutions |  |  |
| Creates a legible model with a description of solution |  |  |
| Revise solutions |  |  |
| Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem |  |  |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Additional Information**

NOTES

· Information that will be useful when teaching this lesson: It may be helpful to present the engineering adaptation separately from the rest of the lesson so that students are clear that they are doing two different activities.

- Resources that will be useful: Copy of the Engineering Design Framework.

- Scaffolds that students will use: If students do not have experience with wind instruments, present the reading on pp. 54-55 as a guided reading lesson, discussing how wind instruments function to produce sound. Discuss different types of instruments (reference a video, the school band/orchestra or music classes.)

Vocabulary:

Collaboration

Design

Problem

Claim

Evidence

Accepting new ideas/suggestions

Making changes

**Engineering: Make a system**

|  |  |  |
| --- | --- | --- |
| **Problem** | **Constraints** | **Criteria** |
| Design an instrument that makes at least 3 pitches. | 1. Use a dowel, tube, mouth  piece, and bulb (only).  2. \_\_\_\_\_\_ minutes  3. Cannot put mouth on materials. | Must make 3 pitches. |

1. Design and sketch 2 possible models for your solution.
2. Select one model with your partner. Why do you think this will be the best solution?
3. Build your best model. Did it work? How can you **optimize** (make it better)?
4. Is your solution the best way to address the problem?